OIPE IAP76
SEP 04 2007
PATENT & TRADEMARK OFFICE

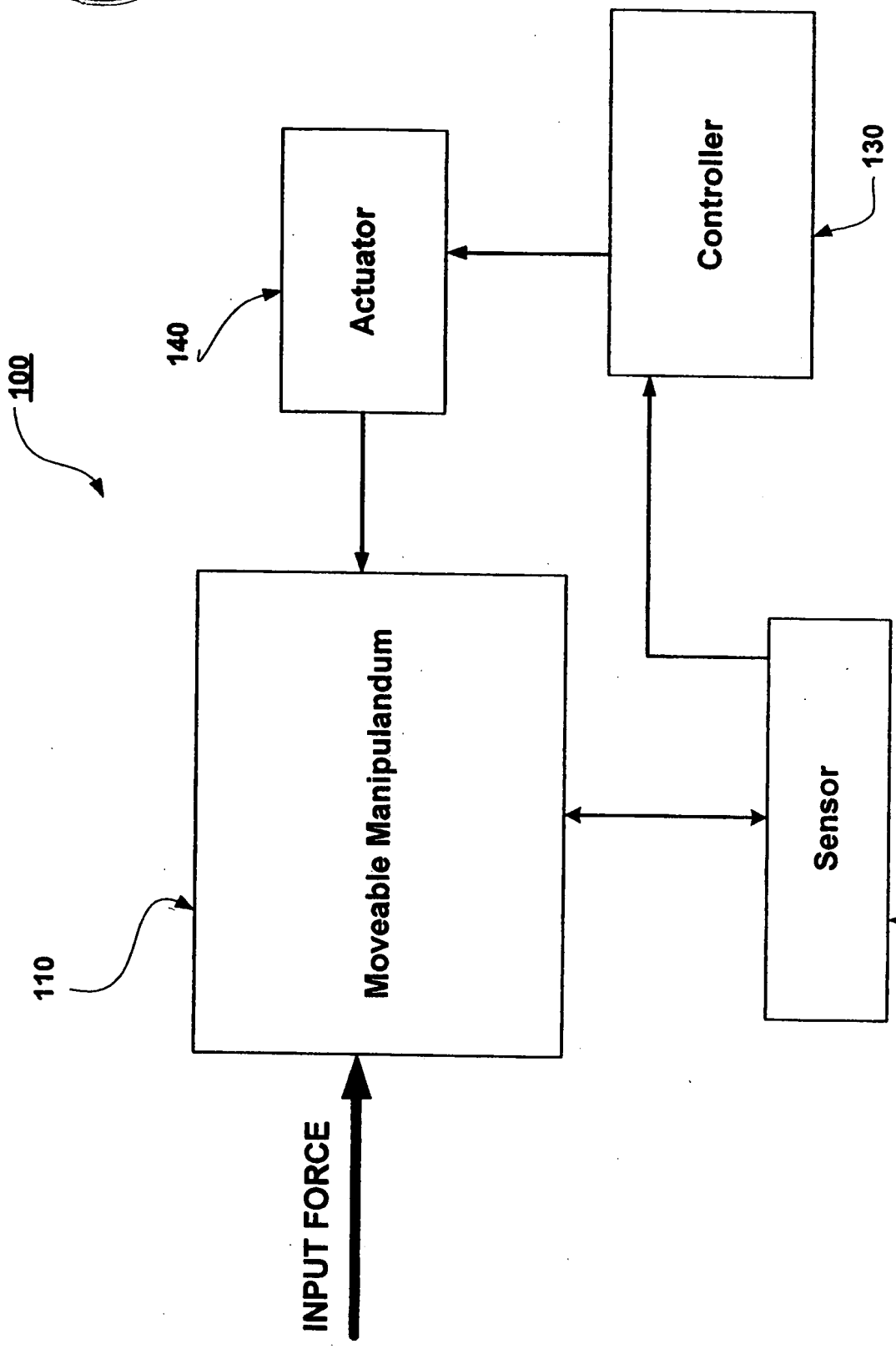


FIG. 1A

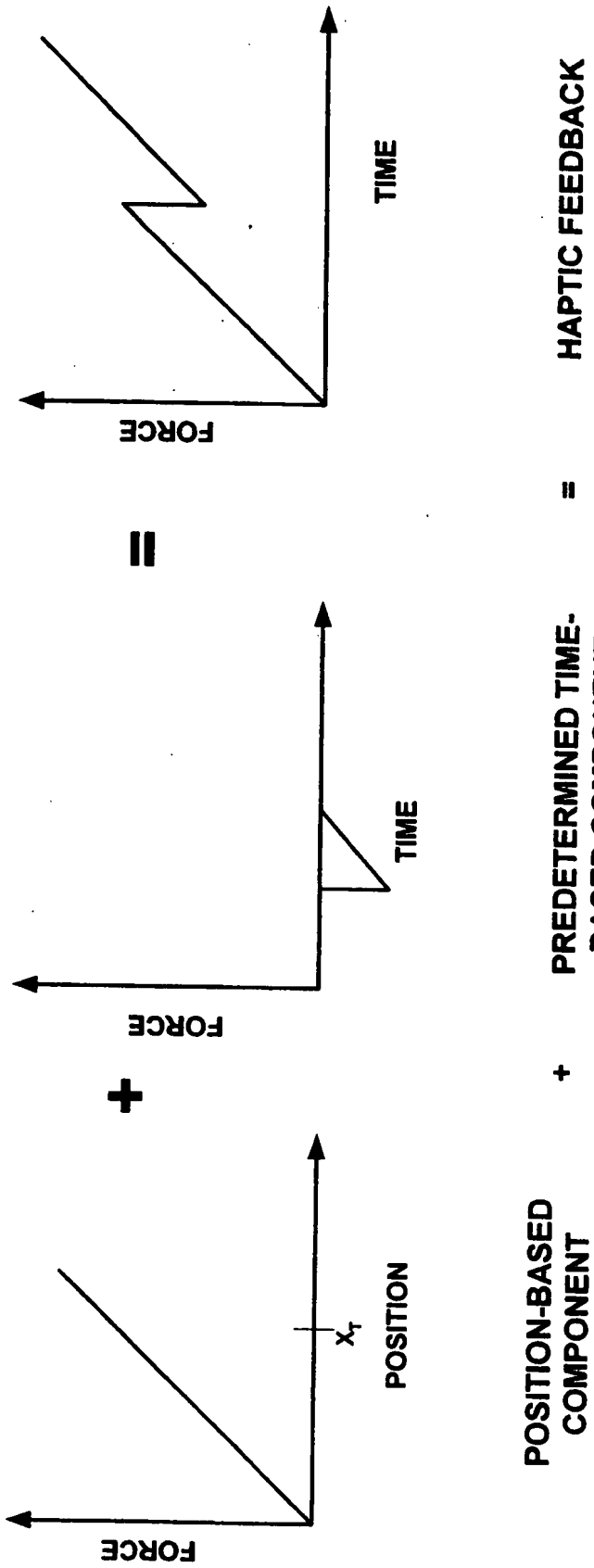

FORCE
TIME
=
HAPTIC FEEDBACK
=
FORCE
TIME
+
PREDETERMINED TIME-BASED COMPONENT
+
FORCE
POSITION
x_T
POSITION-BASED COMPONENT

FIG. 1B

FIG. 2A

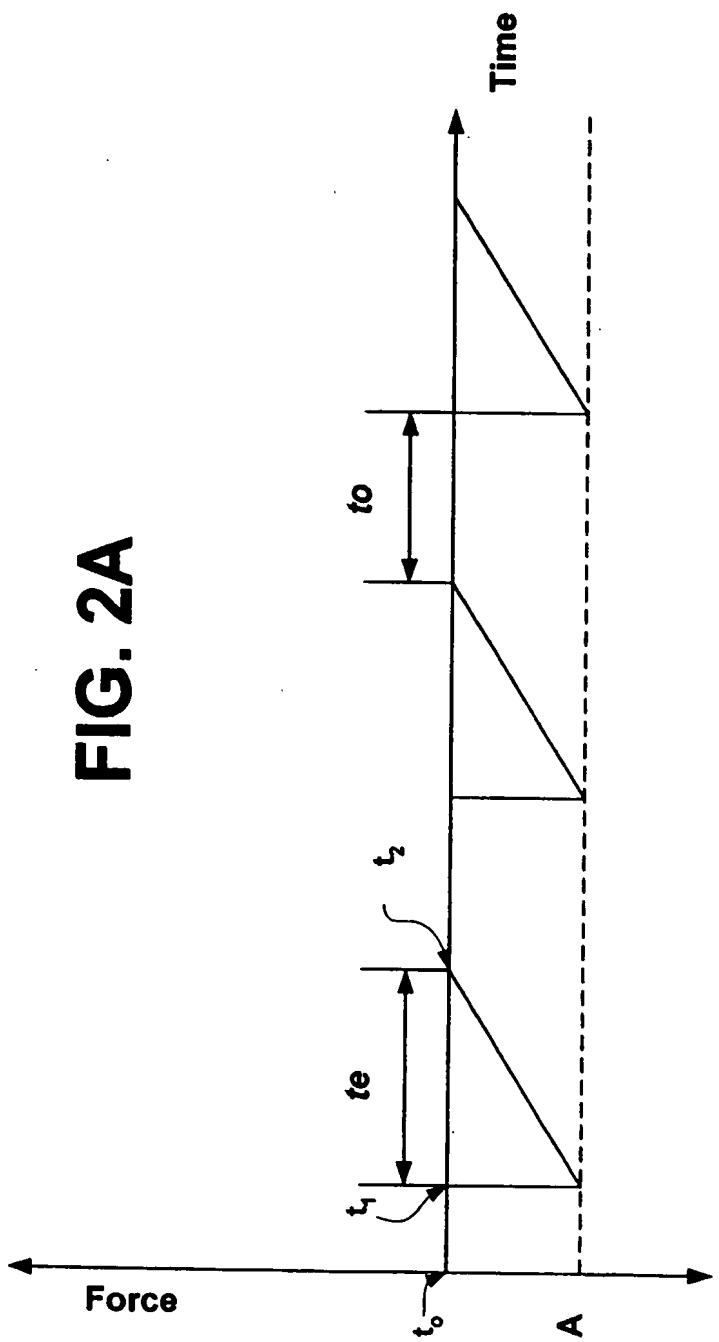

Time
to
te
t2
t1
Force
to
A

FIG. 2B

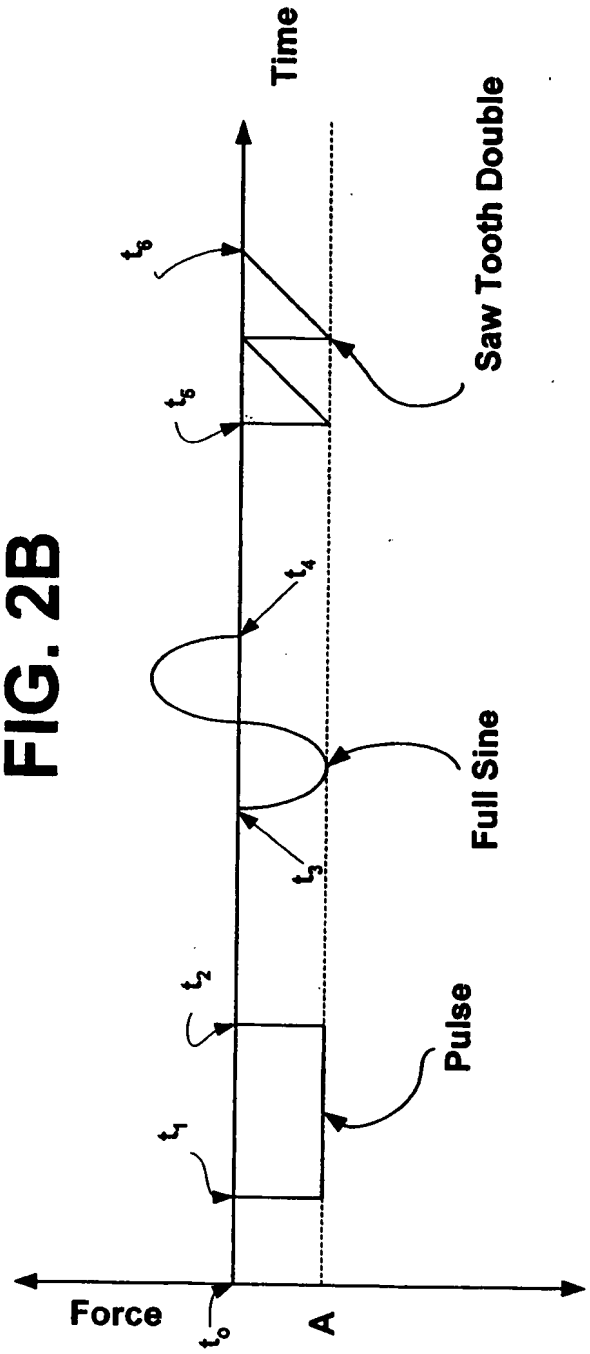
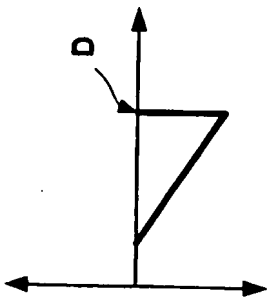
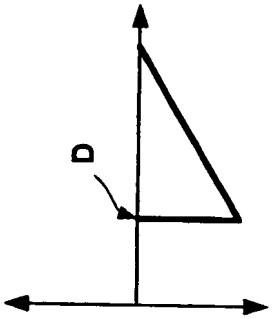

Time
Saw Tooth Double
t6
t6
t4
Full Sine
t3
t2
Pulse
t1
Force
to
A

FIG. 3A



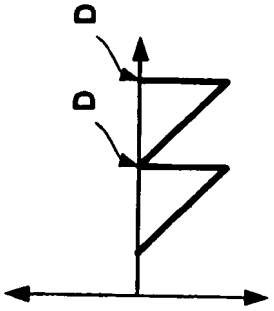
Saw Tooth Down

FIG. 3B



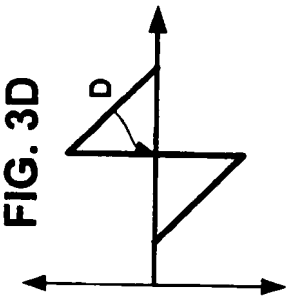
Saw Tooth Up

FIG. 3C



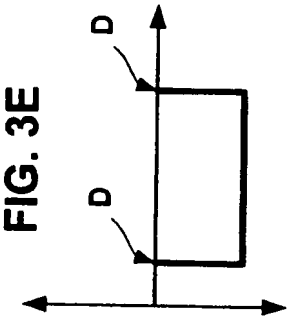
Saw Tooth Double

FIG. 3D



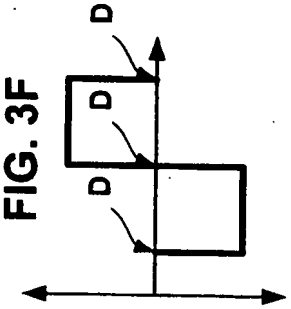
Saw Tooth Wave

FIG. 3E



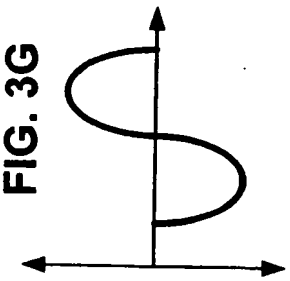
Pulse

FIG. 3F



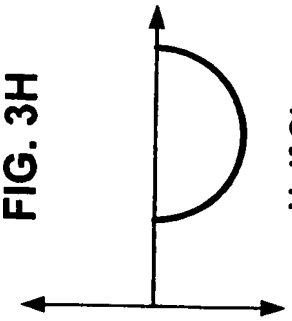
Square Wave

FIG. 3G



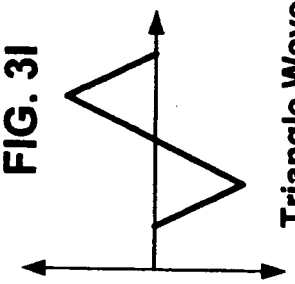
Full Sine

FIG. 3H



Half Sine

FIG. 3I



Triangle Wave

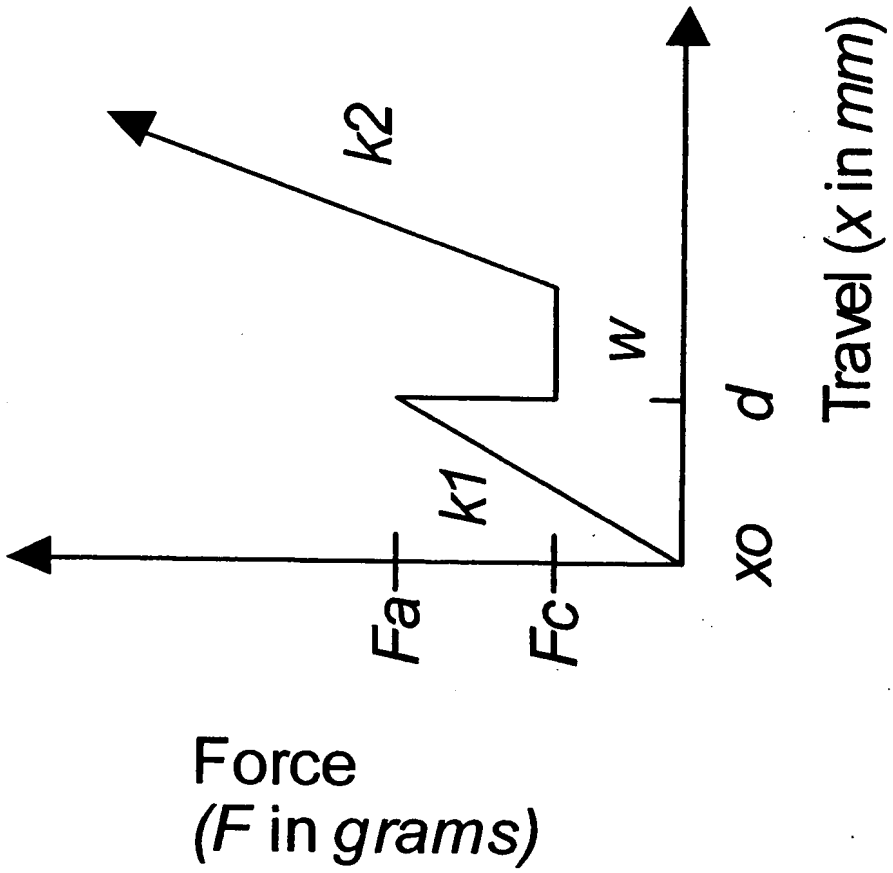


FIG. 4

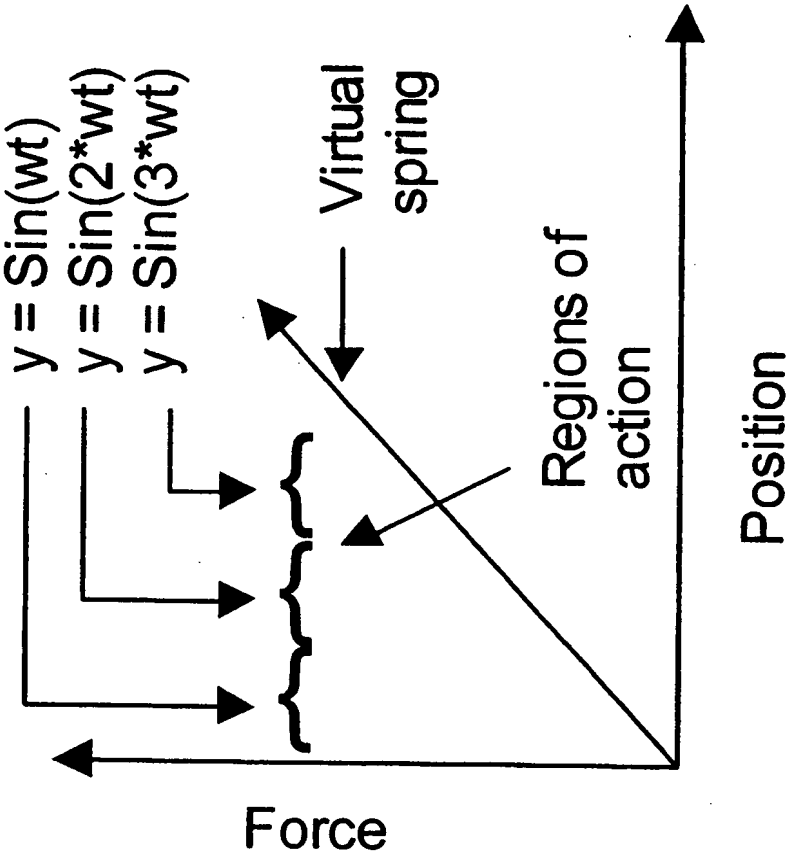

y = Sin(wt)
y = Sin(2*wt)
y = Sin(3*wt)
Virtual spring
Regions of action
Position
Force

FIG. 5

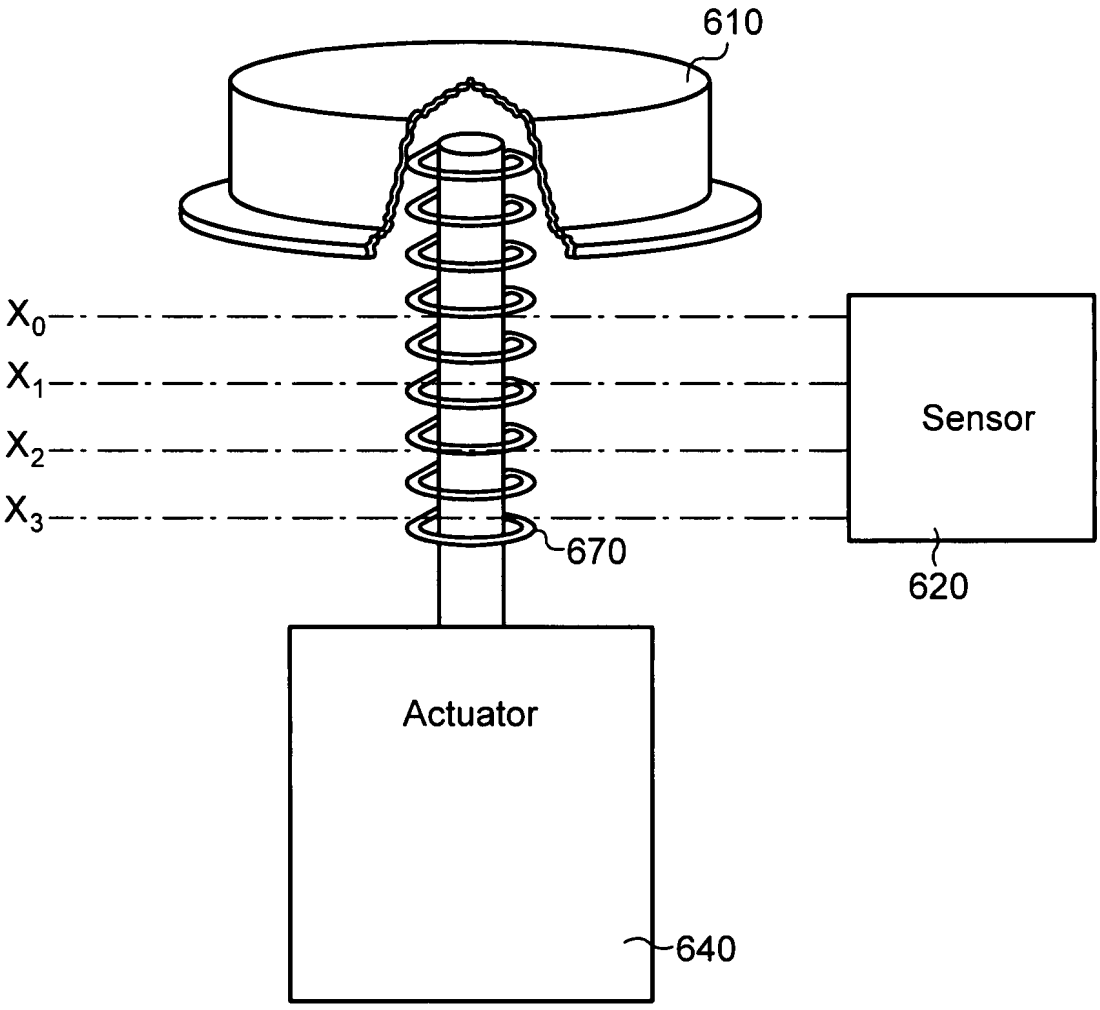


Fig. 6

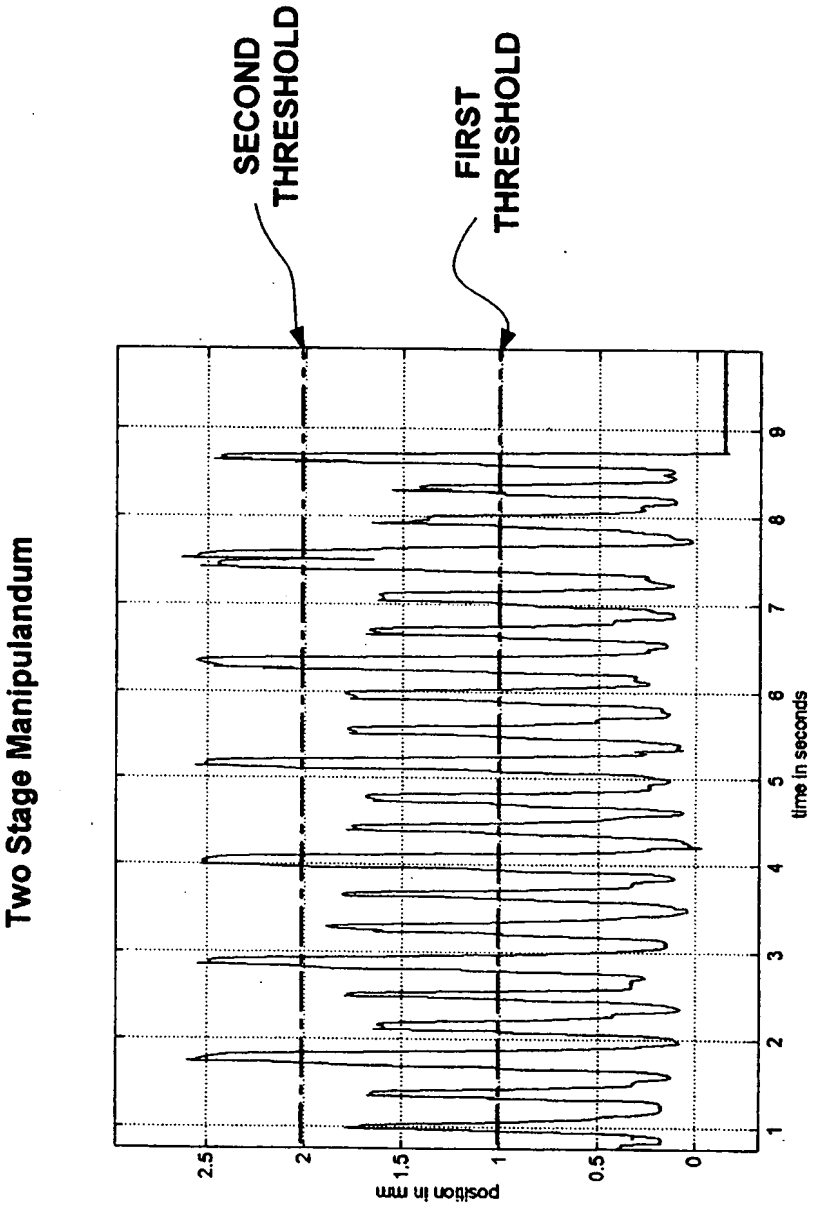

SECOND THRESHOLD
FIRST THRESHOLD
Two Stage Manipulandum
position in mm
time in seconds
2.5
2
1.5
1
0.5
0
1
2
3
4
5
6
7
8
9

FIG. 7

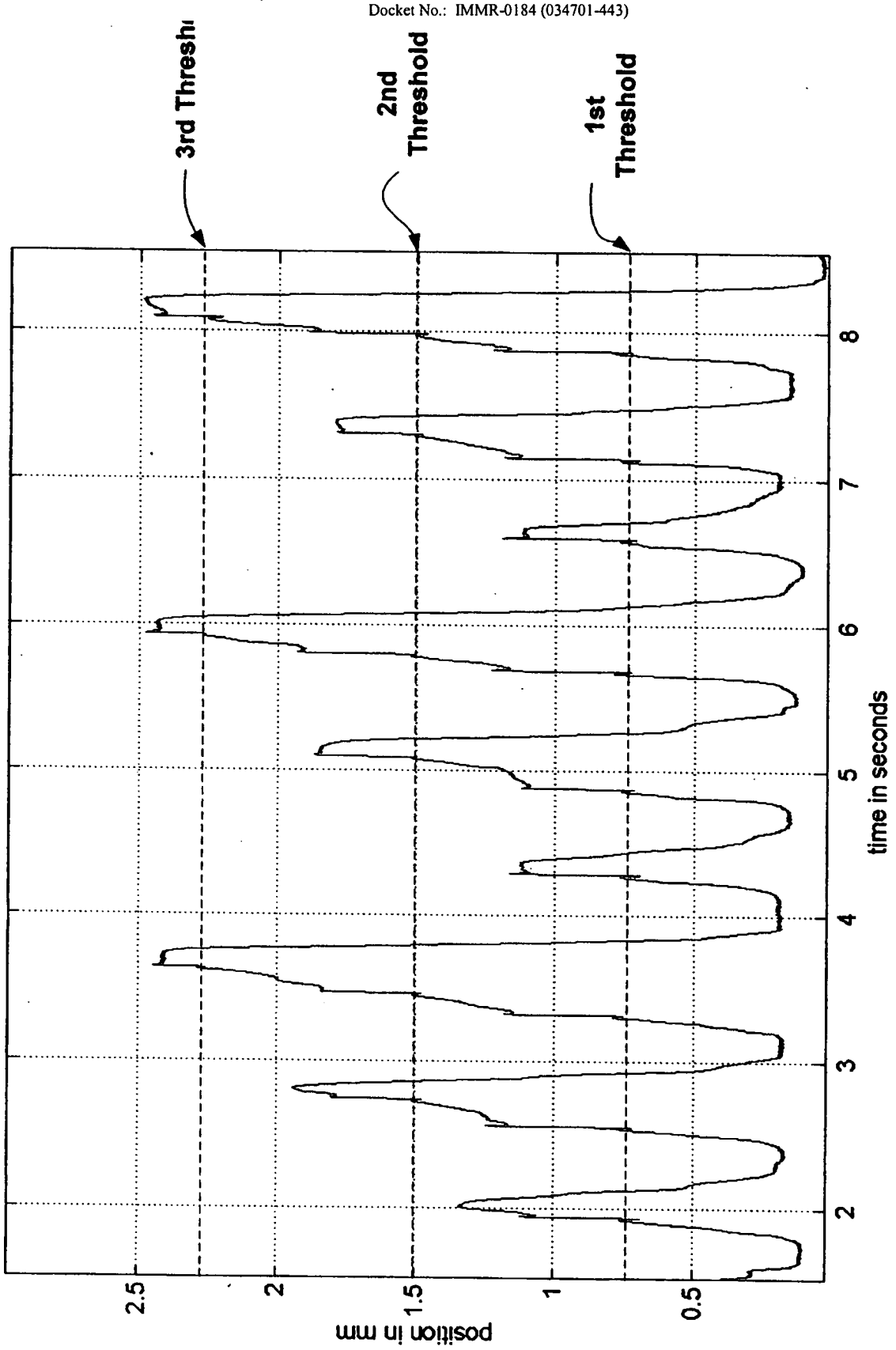

3rd Threshi
2nd Threshold
1st Threshold
position in mm
2.5
2
1.5
1
0.5
time in seconds
2
3
4
5
6
7
8

FIG. 8

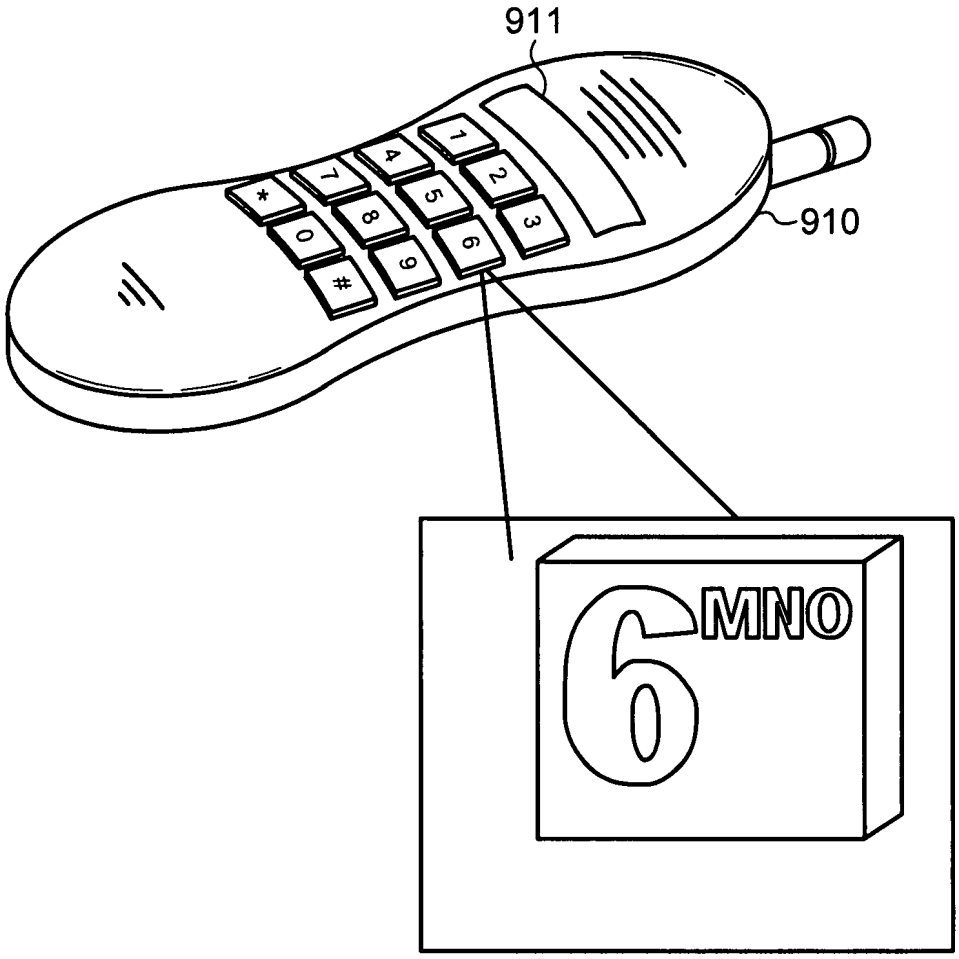


Fig. 9

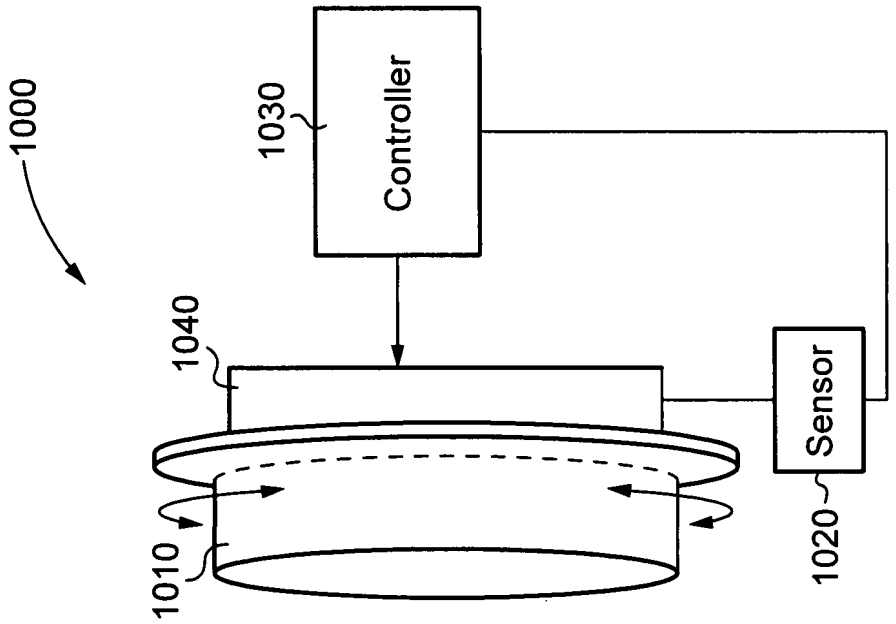


Fig. 10B

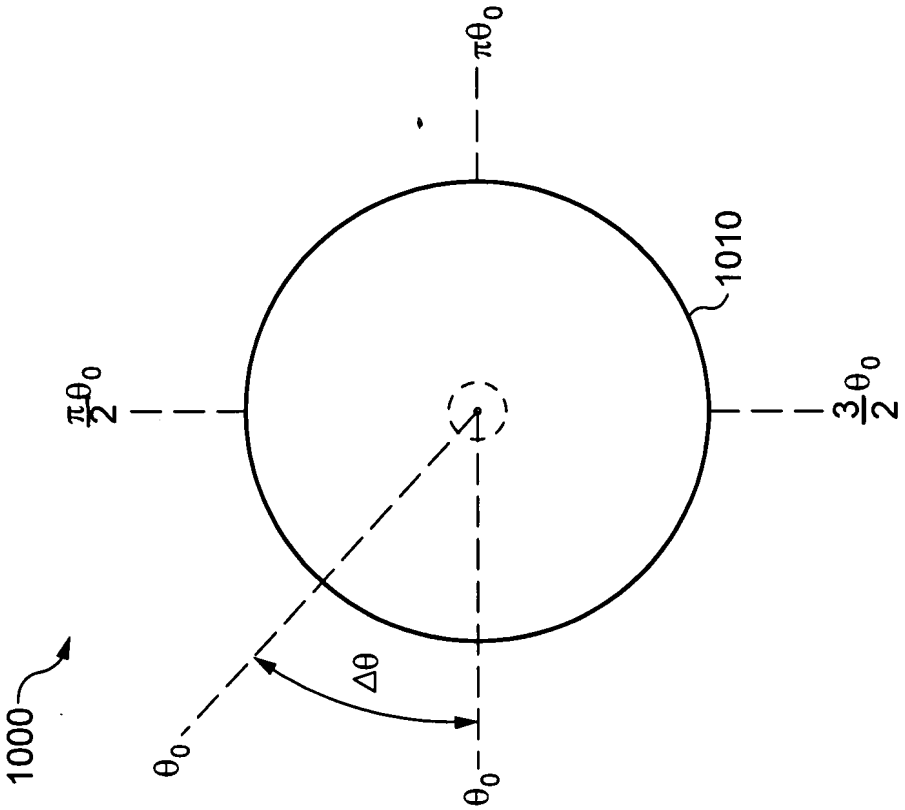


Fig. 10A

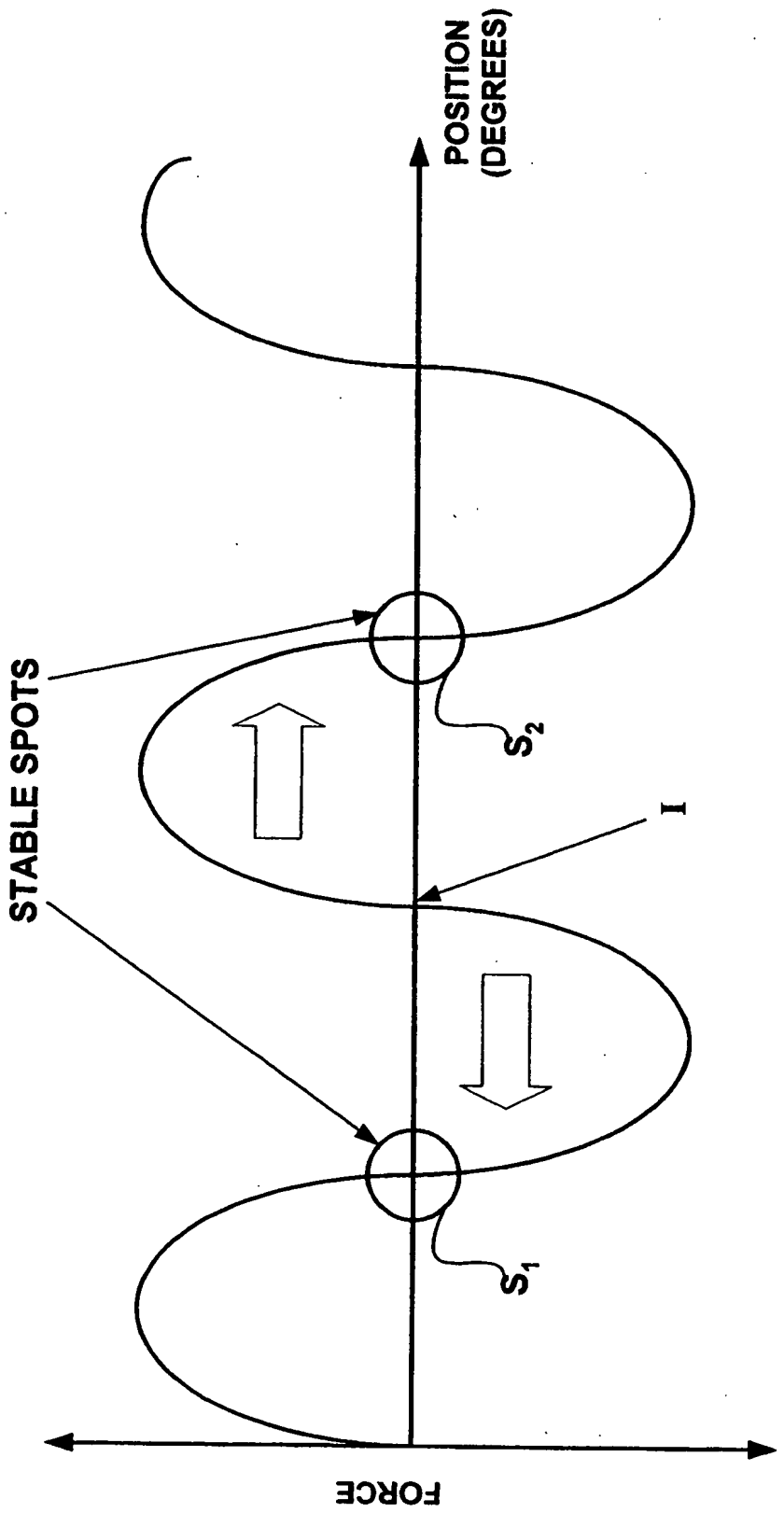


FIG. 11

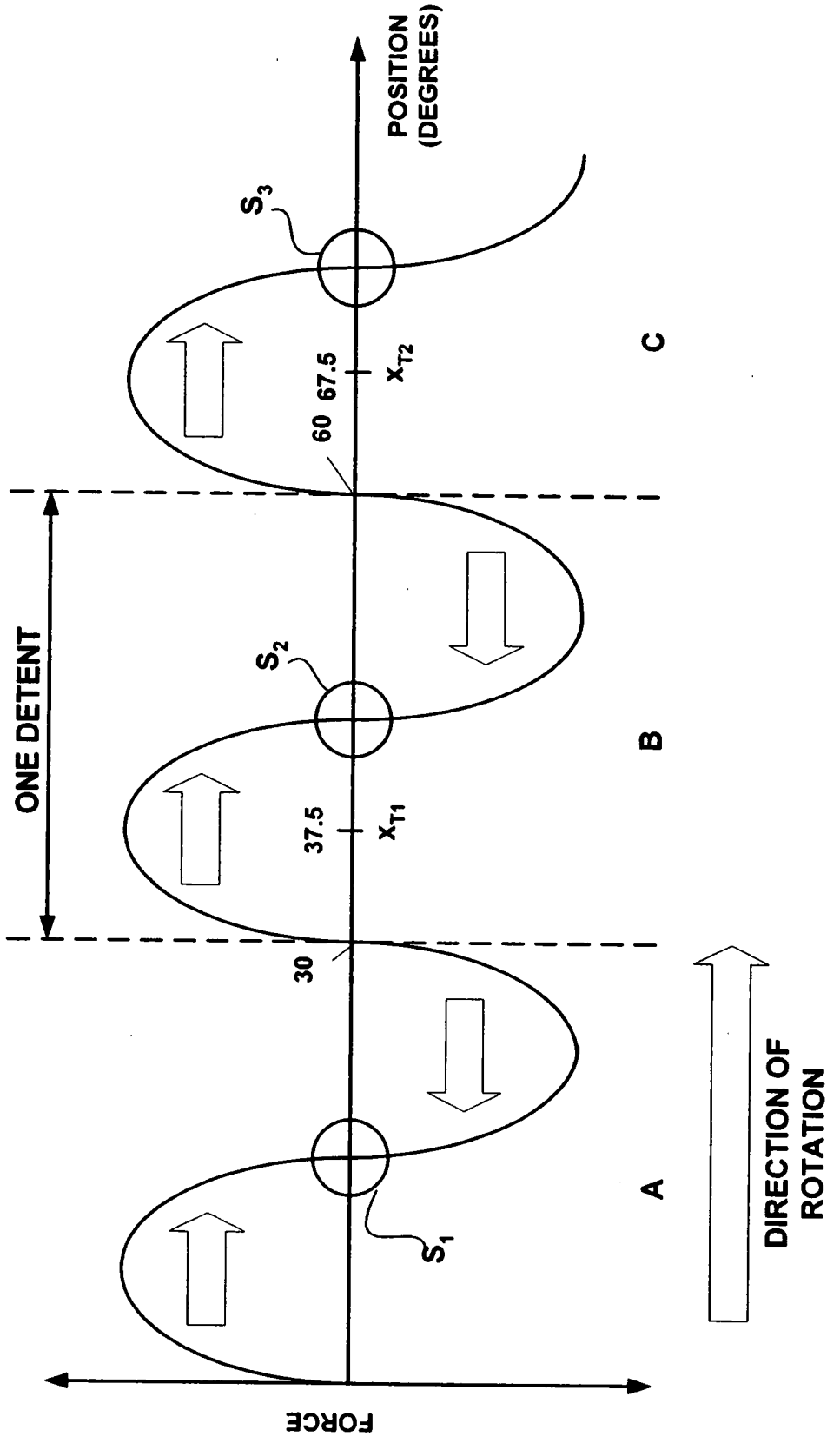

POSITION (DEGREES)
FORCE
ONE DETENT
30
37.5
60
67.5
X_{T1}
X_{T2}
S_1
S_2
S_3
A
B
C
DIRECTION OF ROTATION

FIG. 12

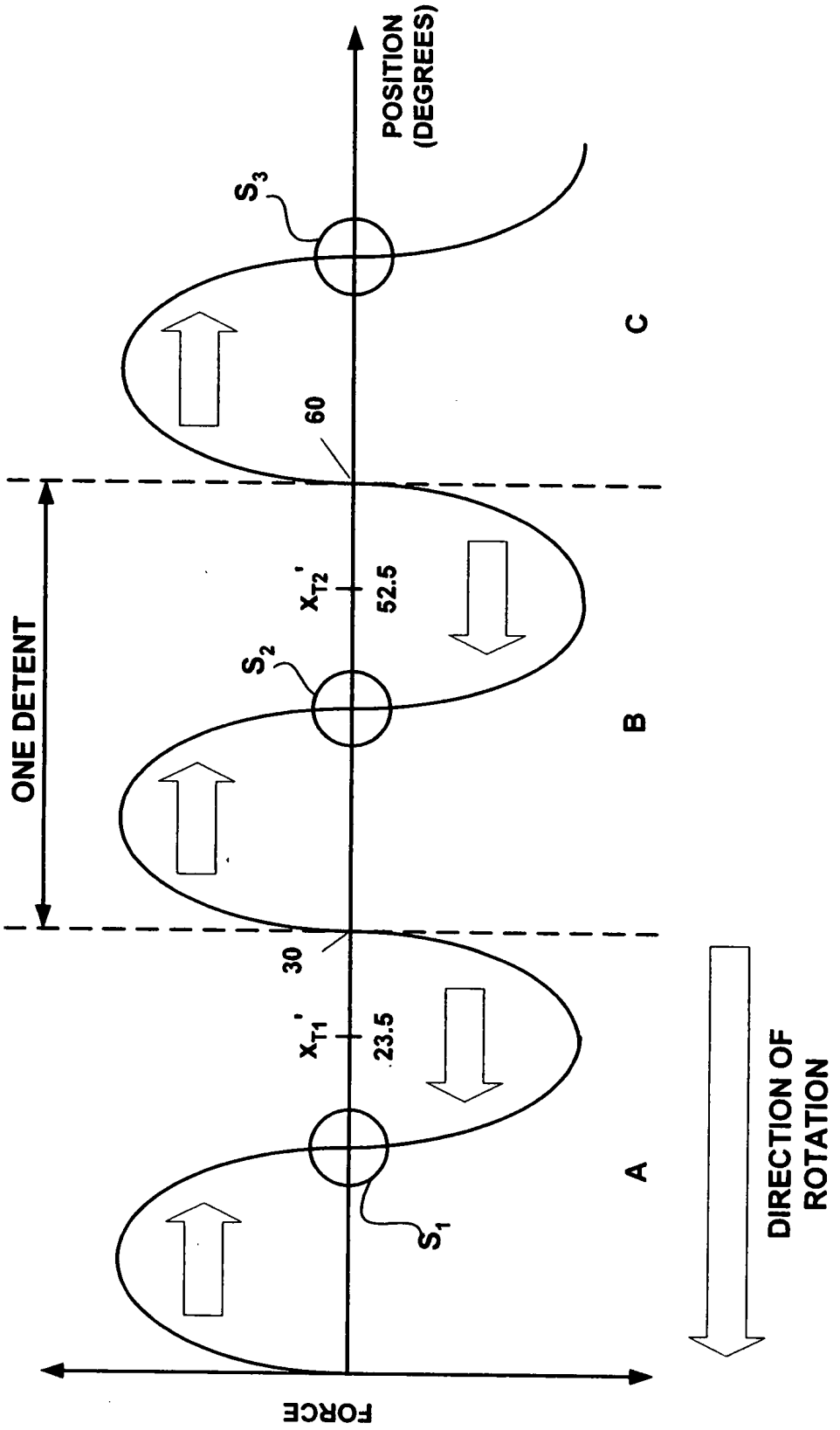

POSITION (DEGREES)
FORCE
ONE DETENT
S_1
S_2
S_3
X_{T1}'
X_{T2}'
23.5
52.5
30
60
A
B
C
DIRECTION OF ROTATION

FIG. 13

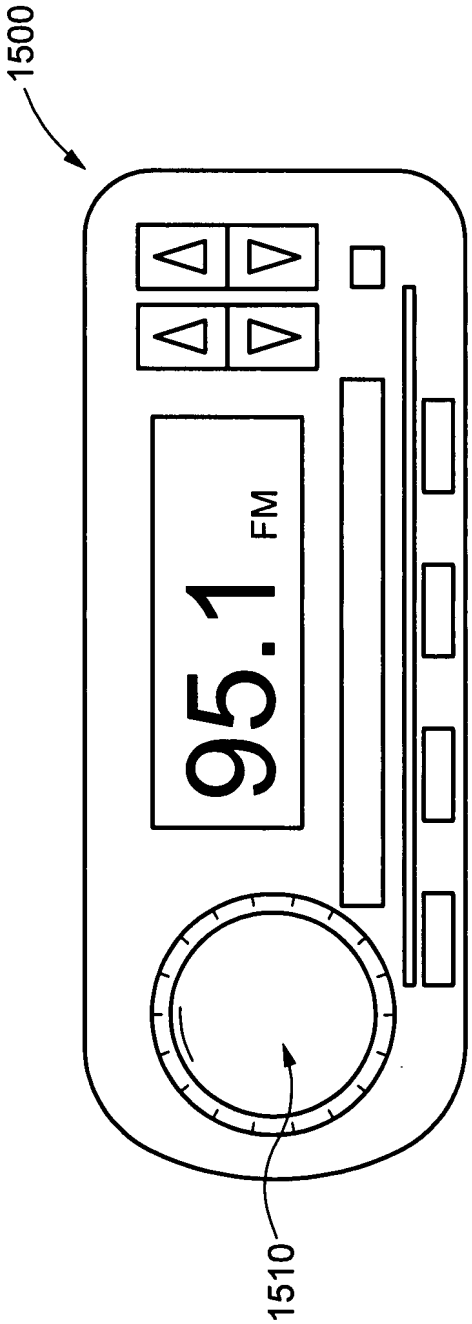


Fig. 14